CALIBRATIONS

TYPE 614C SENSITIVE VALVE VOLTMETER

DAWE

PRECISION
ELECTRONIC
INSTRUMENTS

for
Science and Industry

DAWE

for

Science and Industry

SENSITIVE VALVE VOLTMETER
TYPE 614C

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THIS SPECIFICATION IS APPROVED
FOR USE IN THE CALIBRATION OF
COMPANY INSTRUMENTS. 5
QC FACILITIES CALIBRATION DEPARTMENT
DATE:
BRITISH AIRCRAFT CORPORATION, STEVENAGE.

SENSITIVE VALVE VOLTMETER
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1. SCHEDULE OF PARTS

The complete equipment comprises the following parts:-

1.1. One Instrument Type 614C fitted with the following valves:-

Two - EF86 (Mullard) or Z729 (Osram)
Two - EF91 (Mullard) or 6AM6 (Brimar)
One - ECC81 (Mullard) or 12AT7 (Brimar)
One - EL81 (Mullard)
One - 150B2 (Mullard)
One - EZ80 (Mullard)

Also:-

One - Cartridge Fuse 1A for 200-250V operation or 2A for 110V operation (Belling-Lee Type L1055).

One - Indicator Lamp 8V, 0.2A, M.E.S. cap (Vitality G541).

1.2. One - Screened Jack Plug (Igranic P50 with screen A7589).

1.3. One - Terminal Screen with 3ft coaxial cable (C8890).

1.4. One - Mains lead complete with 3-pole socket.

1.5. One - Instruction Book IB.614C

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2. DESCRIPTION.

2.1. Application

The Type 614C Sensitive Valve Voltmeter is designed for the measurement of voltages from 80μV to 300V at frequencies between 5c/s and 100kc/s. The high input impedance of 10MΩ enables the instrument to be used in measurements associated with high impedance circuits. The instrument is mains operated, extremely compact and portable. It will prove of great value for voltage measurements at frequencies ranging from sub-audio to low ultrasonic. These include vibration studies, frequency response and gain determinations in audio amplifiers, transmission characteristics of filters and output level measurements of oscillators.

2.2. Circuit

The circuit is essentially a high gain amplifier with a precision attenuator, operating a full wave rectifier and indicating meter.

The attenuator is arranged in two sections; a high impedance (10MΩ) frequency compensated section at the input to provide a high input impedance, and a low impedance section after the first of the two amplifying stages. Both sections are operated by a thirteen position range switch giving full scale deflections of 300μV, 1mV, 3mV, 10mV, 30mV, 100mV, 300mV, 1V, 3V, 10V, 30V, 100V and 300V. The attenuator section after the first amplifier stage is designed to operate first to improve the signal to noise ratio at higher input levels.

A 1000V working condenser is used for coupling the INPUT terminals to the first attenuator section, thus enabling a.c. voltage measurement when superimposed on d.c., provided the combined peak level does not exceed 1000V.

Each of the two amplifying stages consist of a two valve circuit giving a gain of about 180, stabilised by 20dB of negative feedback. The stability of the circuit is further enhanced by the use of a low impedance stabilised power supply.

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2. DESCRIPTION (continued)

The reading error from hum, noise and microphony is negligible even on the most sensitive range due to careful circuit design and the use of a particularly suitable input valve.

The meter responds to the full wave average value of the input signal. The rectifier circuit has been specially developed to keep the meter at earth potential to a.c, thus preventing radiation and interference. A robust meter with a full scale deflection of 1.3mA is used. The voltage scales are logarithmic and give a constant reading accuracy at all points on the scale. A linear decibel scale is provided with a reference level of 1V and a total range of -82 to +50dB.

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3. INSTALLATION.

Read the label attached to the instrument and note the information given in respect of the valves and power supply.

3.1. Power Supply

For supplies other than that stated on the label it will be necessary to adjust the mains selector switch at the rear of the instrument. This is a screwdriver adjustment accessible when the mains lead is unplugged.

Check that the correct fuse is fitted (1A for 200-250V operation and 2A for 110V operation).

With the MAINS switch in the off position connect to the mains supply with the lead provided.

Red..... (Mains) Line
Black..... (Mains) Neutral
Other Colour.... (Earth.

3.2. Valves

These are normally supplied fitted in their holders. The various types used are listed in Section 1.1.

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4. OPERATION

4.1. General

The red DAWE pilot lamp indicates when the MAINS switch is set to ON. Five minutes should be allowed for the valve heaters to warm up. However, when first put into operation, or after standing idle for a long time, the instrument should be run for at least 30 minutes before use.

Before taking measurements and when making or removing connections to the INPUT terminals, the range switch should be turned fully clockwise, that is, to the 300V range, in order to afford maximum protection to the instrument against overload or transient surges.

WARNING: Mechanical Zero

The voltage scales are logarithmic and the meter is provided with mechanical bias adjustment to off-set the zero reading. The bias adjustment screw, located on the meter front, should not be touched unless the instrument gives false indications in the low region of the scales.

This can be checked by applying a signal to the INPUT terminals, so as to obtain a reading of 10 on the red dB scale, and switching to the next higher range. The reading should be 0dB. If any discrepancy exists the mechanical bias screw should be adjusted until the meter reads exactly 0dB. Repeat this procedure until correct 0dB and 10dB readings are obtained.

4.2. Voltage Measurements

The range to be used is selected by the range switch which provides the following information when the meter is indicating:-

(a) The voltage corresponding to full scale deflection.

(b) The correct voltage scale to use on the meter.

(c) The number of dB to be added to the meter dB scale.

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4. OPERATION (continued)

The decibel scale is calibrated relative to 1V, which is equivalent to 1mW into 1000Ω. The following table gives the conversion factors required when changing the reference level.

Reference Level	Conversion from dB re. 1V (1mW in 1000Ω)
0.775V, 1mW in 600Ω	Add 2.2dB
1.732V, 6mW in 500Ω	Subtract 4.8dB
1.897V, 6mW in 600Ω	Subtract 5.6dB

Switch to the 300V range and connect the INPUT terminals to the voltage to be measured. Set the range switch to the required full scale value.

Alternating voltages with superimposed d.c. may be measured, provided the combined peak level does not exceed 1000V.

Where possible, measurements should be made at a low impedance level in the test circuit, to minimise errors caused by the additional loading of the voltmeter.

The input impedance is equivalent to a resistance of 10MΩ in parallel with a capacitance of approximately 34pF up to the 10mV range and with about 13pF on the higher ranges.

Connecting leads should be as short as possible, particularly at high frequencies. Reasonably long leads may be used at low frequencies, but for low level determination they should be screened to avoid direct hum pick-up.

A terminal screen fitted with 3ft of coaxial cable is supplied for use when measuring low signal levels in high impedance circuits. This adds about 60pF to the input capacitance.

The meter is calibrated in r.m.s. values for a sine-wave input, the indications being proportional to the full wave average value.

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4. OPERATION (continued)

4.4. Output Jack

An OUTPUT jack is provided to monitor the signal or to enable the instrument to be used as a high gain amplifier, the maximum amplification available being about 88dB that is about 27000 times. The amplifier output is approximately 8V r.m.s. at full scale deflection into a minimum load resistor of 10kΩ. The source impedance is approximately 20Ω. When measuring small voltages in high impedance circuits or at high frequencies, a screened output lead is required to prevent coupling between input and output leads. The screened output jack supplied with the instrument should be used.

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5. MAINTENANCE

5.1. Removal of Side Covers

Disconnect the instrument from the mains supply before attempting to remove the covers.

To gain access to the chassis, unscrew the single 4B.A. chromium screw immediately above the DAWE name plate at the bottom of both front and rear panels.

Remove the metal bezels by grasping the bottom edge and pulling forward and upward.

Grasp the top edge of one side cover and pull outwards to remove it completely. Similarly remove the other side. The valves and chassis components are then readily accessible.

5.2. Valves and Indicator Lamp

The valves and the lamp are standard commercial types and do not normally require selection. The various types used are listed in Section 1.

If it becomes necessary to change V1-V7, the amplifier gain should be checked as described in Section 5.3.

If the stabiliser valves V5-V7 are changed the h.t. at the cathode of V5 should be checked (limits 235 to 255V).

5.3. Amplifier Gain

An internal gain control R24 is provided and is located on the valve chassis between V3 and V4.

Adjustment should not be attempted unless accurate calibration facilities are available.

However, if the accuracy is suspected if valves are changed the following procedure should be adopted:-

(a) Set the MAINS switch to ON and allow the instrument to stabilise for 15 minutes.

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5. MAINTENANCE (continued)

(b) Measure the stabilised h.t. at the cathode of V5 to ensure that it is between 235 and 255V.

(c) Adjust the meter zero ts described in Section 4.1.

(d) Set the range switch to a convenient range and compare the meter reading with an accurate standard voltmeter when equal signal voltage is applied to both instruments. The signal frequency should be between 50c/s and 1kc/s with a total distortion of less than 1%. If necessary adjust R24 to align the instrument with the standard voltmeter. High stability resistors are used in the attenuator and unless a resistor is damaged, accurate readings should be obtained on each range.

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6. SPECIFICATION

Voltage Range:	Thirteen voltages ranges are provided with full scale meter deflections of 300μV, 1mV, 3mV, 10mV, 30mV, 100mV, 300mV, 1V, 3V, 10V, 30V, 100V and 300V.
Accuracy:	Better than ± 2% of indication on all ranges with a sinusoidal input.
Frequency Error:	Less than ± 3% from 5c/s to 100kc/s.
Input Impedance:	Approximately equivalent to a resistance of 10mΩ in parallel with a capacitance of approximately 34pF up to the 10mV range and with about 13pF on higher ranges.
Scale Calibration:	Meter calibrated in r.m.s. values for a sine-wave input, the indications being proportional to the full-wave average value.
Amplifier Output:	Approx. 8V r.m.s. at F.S.D. into a minimum load resistor of 10kΩ. Source impedance 20Ω approximately. Maximum gain about 88dB (Approx. 27000 times.)
Power Supply:	110V and 200-250V, 50-60c/s, 40W approximately.
Mounting:	Compact portable metal cabinet finished black with polished bezels.
Dimensions:	6½" x 10" x 9½" high.
Weight:	14 lb approximately.

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